An Updated Scoping Review of Popular Stress Management Mobile Applications

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Abstract

Cognitive behavioral therapy (CBT) and mindfulness are evidence-based methods shown to support positive stress management. Smartphone applications have the potential to guide people through CBT and mindfulness strategies. The purpose of this scoping review is to update the evidence on stress management mobile applications "apps." We specifically aim to provide an overview of stress management app characteristics and app quality. Following the PRISMA-ScR checklist, the Apple App Store and Google Play store were systematically searched from the perspective of a patient seeking an app to help with stress management. Descriptive data was entered into an excel spreadsheet and the end-user Mobile Application Rating Scale (uMARS) was used to determine app quality. A total of 14 apps met inclusion criteria and were evaluated. We found that though these apps scored above average on the uMARS scale, there was still room for improvement. Many apps were not available in languages other than English. Cumulative uMARS scores indicated that stress management apps in this study were of above average quality, but there are room for improvements. Engagement, subjective quality, and perceived impact scores were the lowest. To have a meaningful impact on health, it is important to continuously evaluate app quality to guide meaningful design and development.

Keywords: Mobile applications, stress, mental health, mHealth

An Updated Scoping Review of Popular Stress Management Mobile Applications

Chronic stress has been on the rise in the United States, with 44% of adult's report feeling moderate to severe levels of stress (American Psychological Association [APA], 2015). In 2015, the average U.S. adult reported that their stress level was an average of 5.1, with 1 being little to no stress and 10 being extremely stressed (APA, 2015). What makes these rises in stress levels so alarming is the fact that stress can have a devastating impact on both physical and mental health. Chronic stress is associated with various illnesses including cardiovascular issues, diabetes, cancer, etc. Chronic stress is linked to changes in the brain, immune response, and biochemical pathways (Mariotti, 2015). Stress disproportionately impacts vulnerable members of our population including minorities (with Hispanics reporting the highest levels), individuals with disabilities, those with lower incomes, and women (Belar, 2017). Social determinants of health often play a factor in stress management. Social determinants of health are conditions that may influence health outcomes such as where a person lives, access to care, or socioeconomic status (American Academy of Family Physicians [AAFP], 2018).

However, there are many evidence-based stress management techniques that are effective in supporting positive stress management. Common evidence-based strategies to support positive stress management are mindfulness and cognitive behavioral therapy (CBT). Mindfulness aims to increase awareness of one's own thoughts, feelings, and emotions from moment to moment (Economides et al., 2018; Keng et al., 2011). Within the umbrella of mindfulness lies two highly effective interventions: mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT). Mindfulness encompasses strategies such as awareness, acceptance to experiences, and openness to new perspectives (Economides et al., 2018; Mani et al., 2015). Such strategies have demonstrated improvements in reducing stress,

anxiety, and depressive symptoms (Economides et al., 2018; Mani et al., 2015). Borrowing from mindfulness and other psychotherapeutic modalities, CBT is an evidence-based method that helps individuals identify goals and help them achieve these goals through strategies such as reframing negative thoughts, problem solving, and overcoming barriers (Beck Institute of Cognitive Behavioral Therapy, 2019). Such interventions can be learned through skills practice but require regular practice and sustained effort in order to be effective (Mani et al., 2015; Beck Institute of Cognitive Behavioral Therapy, 2019).

However, not everyone can afford to see a therapist or to take a class on stress coping skills, therefore, alternative methods are needed to increase the reach and quality of stress-management resources. Since the development of smartphones in the early 2000s, there has been a surge in the number of users, with about 81% of Americans now owning smartphones (PEW Research Center, 2019). Given the high smartphone ownership rate, there is great potential to reach broad audiences. As a result, many apps have been created that claim to assist in stress management and encourage healthy coping skills. Several systematic and scoping reviews across diverse outcomes have been conducted on mindfulness and CBT apps (Mani et al., 2015; Huguet et al., 2016; Rathbone & Prescott, 2018; Stawarz et al., 2018; Weisel et al., 2019). One example would be Huguet et al., 2016, who at the time found that there were only about 12 CBT based apps to assist with depression, and there was a huge variability in usability (Huguet et al., 2016). Rathbone's systematic review on the efficacy of CBT-based mental health apps saw that there were improvements for patients with mental health issues such as anxiety, OCD, and PTSD (Rathbone et al., 2018). Stawarz and colleagues (2018) found a mix of features offered through apps, many not based on CBT practices. Collectively, the reviews found little evidence to suggest app efficacy for treating mental health and further indicated that apps should not be used

as standalone treatment. However, when used in conjunction with clinical practice and developed with respect to evidence-based treatment and user-centered design, apps may enhance stress-management strategies due to potential reach and usability across various populations (Stawarz et al.,; Rathbone et al., 2018). Based on the ever-changing landscape of mobile apps, it is important to continue evaluating the most current evidence for the usefulness of these applications and inform healthcare providers and patients.

Purpose

The purpose of this scoping review is to update the evidence on mobile applications (apps) delivering interventions to manage stress. Specifically, we aim to provide an overview of stress management app characteristics and systematically evaluate stress management app quality.

Methods

The study was conducted following the PRISMA-ScR checklist. An electronic search was conducted of two widely popular app stores, Apple App Store (for Apple/iPhone products) and Google Play Store (for Android-based products). The stores were searched between July and August 2019. To mimic terms the general public may use, each store was searched separately using the terms “stress management” or “mindfulness” with no restrictions applied related to search subcategories. Searches were not limited by language or date of app publication. Apps met the study inclusion criteria if they promoted strategies to teach/promote stress management, were available through both stores (Apple App Store and Google Play Store), available in English, and were either free or offered a free trial prior to purchase. Two investigators performed app search and selection independently (CD, JS), and any disagreements among selection were resolved by a third investigator (LKM).

Apps that met inclusion criteria were systematically evaluated for characteristics and quality following a protocol established apriori. Data obtained through the free/basic version of the app was extracted and placed into a Microsoft Excel spreadsheet. App characteristic data included: app name, developer, version, available languages, recommended ages, evidence of support (i.e., clinical trial or face validity). Apps were evaluated to determine if evidence-supported CBT and/or mindfulness techniques such as reframing negative thoughts, progressive muscle relaxation, guided imagery, or diaphragmatic breathing were promoted/utilized by the app. Three investigators (CD, JS, LKM) independently extracted the data. Two investigators (CD, LKM) reconciled any differences.

App quality was assessed using the end-user version of the Mobile Application Rating Scale (uMARS; Stoyanov et al., 2016). Adapted from the earlier Mobile Application Rating Scale (Stoyanov et al., 2015) that requires users to undergo training before evaluating a digital health tool, uMARS provides a simplified method with proven reliability and validity for assessing mobile app quality based on four broad categories: engagement, functionality, aesthetics, and information (Stoyanov et al., 2016; "App Evaluation Example," 2020; "Why Rate Mental Health Apps?" 2020). Engagement refers to how much the user wants to interact with the app. Functionality refers to how easy the app is to navigate and use. Aesthetics refers to how visually appealing the app is to the user. Lastly, information refers to how quality the content is on the app. Two junior researchers (CD, JS) performed independent app quality assessment using uMARS. To reduce bias, app quality scores were calculated by averaging junior researcher scores in combination with an objective, third-party MARS score (Stoyanov 2015) provided by trained professionals and posted on the Psyberguide app repository (Psyberguide, 2020) or by a third, more senior researcher (LKM). Investigators were blind to other reviewer ratings until

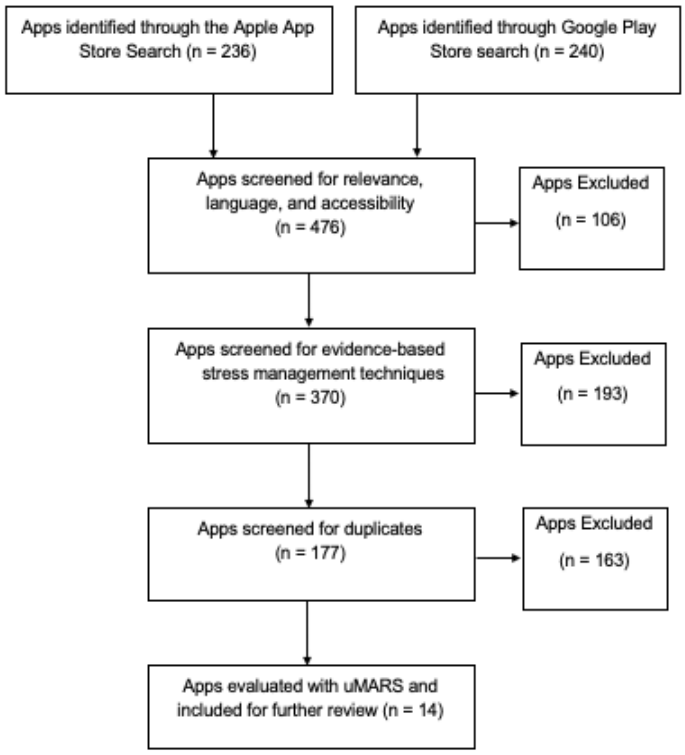
after all data was extracted. If an app was identified by our search, but not available through Psyberguide, the senior researcher (LKM) uMARS scores were used as a third score. Cumulative app quality was determined by averaging mean scores for engagement, functionality, aesthetics, and information sections. uMARS subjective scores for quality and perceived impact were not used to calculate app quality but are individually reported by the investigators.

Results

Our search yielded several apps (n=177), yet, only 14 apps met our inclusion criteria and were further analyzed (Figure 1).

Figure 1

Flow diagram of app search



App Characteristics.

About 71.4% of apps focused on a combination of mindfulness and meditation for stress management techniques, while the remaining focused on a singular technique such as deep breathing or visualizations. About 28.6% of apps were offered in languages other than English. Average user-ratings differed for apps by store. Google Play Store apps averaged 4.27/5 stars and Apple App Store apps averaged 4.66/5 stars, 5 being the best rating for both stores. Descriptive data for selected apps are presented in Table 1.

Table 1

App characteristics

App Name	DEVELOPER	AVAILABLE IN LANGUAGES OTHER THAN ENGLISH?	RECOMMENDED AGES[A]	APPLE APP STORE[C]	GOOGLE PLAY STORE[C]	CLINICAL STUDIES?	FACE VALIDITY EVIDENCE-SUPPORTED TECHNIQUE
CALM app		Yes	4+/E	4.8	4.3	2.75	Meditation
Headspace		Yes	4+/E	4.9	3.8	3.58	Mindfulness/Meditation
Sanvello		Yes	12+	4.8	4.6	4.58	Mindfulness/Reframing
The Breathing App	Edwin Stern	Yes	4+/E	4.6	4.0	2.08	Resonance Breathing
EnVision		No	4+/E	4.8	4.0	2.75	Guided Visualization
Mindful Moments	Cleveland Clinic	No	4+/E	N/A[D]	N/A[D]	3.00	Meditation
Stress and Anxiety Companion		No	4+/E	N/A[D]	N/A[D]	3.25	Mindfulness, Visualization
Mindfulness: Being Human		No	4+/E	N/A[D]	4.5	2.58	Mindfulness
Destressify		No	4+/E	N/A[D]	3.7	2.41	Mindfulness
Humm.ly		No	4+/E	4.8	N/A[D]	3.08	Mindfulness Music Therapy
Sky Tripping		No	4+/E	4.6	N/A[D]	2.00	Guided Imagery
Breath Ball		No	4+/E	4.9	4.8	2.67	Breathing Exercises
Unwinding Anxiety		No	12+	4.9	4.7	3.33	Mindfulness, Journaling
Smiling Mind		No	4+/E	4.6	4.4	4.33	Mindfulness/Meditation

Google Play Store: E for everyone[A]
Apple App Store: 4+[B]
User-ratings out of 5, 5 being the best[C]
Not enough reviews[D]

App Quality

For the purpose of this research and per MARS/uMARS instructions, app quality was determined by averaging sections A (engagement), B (functionality), C (aesthetics), and D (information). In our analysis, the top three scoring apps for quality were Smiling Mind (4.28/5), Sanvello (4.7/5), and Headspace (4.29/5). All three promoted CBT-based and/or mindfulness techniques as part of their programs such as meditation and reframing negative thoughts.

Cumulatively, all apps scored lower than average in subjective quality (3.03/5), which is a score based on the user's initial opinion on the quality of the app (how often they may use it, how many stars they would give it, etc). Similarly, perceived impact scores averaged 3.08/5 suggesting that the users believe the apps have an above average ability to make lasting changes in the users' attitudes and behaviors. Lastly, apps scored high in aesthetics (4.07/5) compared to the previous categories, showing that users perceived the apps as being visually appealing but not as effective.

The average engagement score for the 14 apps reviewed was 3.59 out of 5, showing that these apps had an acceptable level of engagement. The apps that rated the highest for engagement (i.e., 4 or higher) were Sanvello with a score of 4.8 and Headspace with a score of 4. Both applications send alerts, keep track of your progress overtime, give feedback, and allow for sharing. In assessing overall functionality of the apps reviewed, the average score in this category was an impressive 4.19 out of 5. Again, both Sanvello and Headspace scored well. Both apps provide multiple functions such as mood/behavior tracking, and community support along with the evidence-based therapeutic interventions. Overall, app information score averaged 3.80, with Headspace rating the highest, followed by Unwinding Anxiety. Both apps contained thorough content that came from credible sources and were based on clinical studies.

Table 2

App quality

App Name	ENGAGEMENT[A]	FUNCTIONALITY[A]	AESTHETICS[A]	INFORMATION[A]	CALCULATED QUALITY SCORE[B]	SUBJECTIVE QUALITY SCORE	PERCEIVED IMPACT SCORE
CALM app	3.60	4.46	4.50	3.62	4.05	2.75	2.94
Headspace	4.00	4.71	4.83	4.98	4.29	3.58	3.00
Sanvello	4.80	4.83	4.89	4.29	4.70	4.58	4.17
The Breathing App	2.86	4.33	3.66	3.16	3.51	2.08	2.16
EnVision	3.27	4.17	4.11	3.50	3.76	2.75	3.00
Mindful Moments	3.27	4.33	3.78	4.33	3.93	3.00	3.28
Stress and Anxiety Companion	3.87	4.50	4.22	4.00	4.15	3.25	3.56
Mindfulness: Being Human	3.33	4.00	3.22	4.08	3.66	2.58	3.72
Destressify	3.40	3.50	3.22	4.16	3.57	2.41	2.83
Humm.ly	3.73	3.92	4.44	3.33	3.86	3.08	2.61
Sky Tripping	2.93	3.50	4.44	3.00	3.47	2.00	1.94
Breath Ball	3.47	4.08	3.00	2.33	3.22	2.67	2.00
Unwinding Anxiety	3.93	3.92	3.89	4.42	4.04	3.33	4.00
Smiling Mind	3.73	4.50	4.76	4.10	4.28	4.33	3.95
Average Rating	3.59	4.19	4.07	3.81	3.89	3.03	3.08

Scores range 1 low to 5 high[A]

Calculated from engagement, functionality, aesthetics, information[B]

Gaps in the Research

A major gap of this study is the lack of information obtained regarding patient/consumer privacy. For example, while several of the apps were rated E for everyone (Google Play Store) or ages 4+ (Apple App Store), it is unknown what safeguards were implemented to protect the online rights of children, particularly with regard to Children's Online Privacy Protection Rule (COPPA).

Another major gap would be our exclusion of the pediatric population in our research. We had many apps that were rated E for everyone or 4+, but we excluded ones that had a sole focus on the pediatric or adolescent population.

Discussion

App Characteristics

The purpose of this study was to update the evidence on apps delivering interventions to manage stress. Similar to previous studies (Huguet et al., 2016; Stawarz et al., 2018; Weisel et

al., 2019), we found a lack of evidence regarding the efficacy of stress-management mobile applications. The number of evidence-based apps (i.e., supported via clinical studies) has grown throughout the years, but they are still in the minority. However, given an increased need to improve access to quality and continued public use of such apps, there is merit for app use as an adjunct to clinical practice. Our analysis suggests potential for high perceived impact, which could broaden the reach for stress management support. However, few apps were offered in languages outside of English, limiting potential reach. Further studies need to be done on diverse populations as well as pediatric populations (Anderson-Lewis et al., 2018).

App Quality

Sanvello and Headspace both had the highest engagement scores and allowed for a lot of interaction and customization such as goal setting and user-selected themes. One strategy that app developers use to increase engagement is gamification. Gamification uses game design elements in a non-game app to promote user engagement (Lopes et al., 2019). Studies have shown that gamification is an effective way to increase engagement in mental health applications (Fleming et al., 2016; Pramana et al., 2018). However, we did not find this in our sample. Gamifying apps has a potential to create apps that the general public wants to be using but is not the end all be all. Apps can be created that have high engagement without gamifying them.

In terms of functionality, Sanvello and Headspace ranked as the top again. Research has shown that apps that used evidence-based strategies tend to have fewer appealing features (i.e. engagement features that promote continuous use) compared to those apps that did not use evidence-based techniques (Stawarz et al., 2018). This suggests that app developers creating apps with evidence-based techniques need to include more features that increase engagement. In

the 14 apps reviewed here, there was definitely an increase in these features since that article was published, with two evidence-based apps scoring high marks.

For aesthetics, how an app looks can potentially impact whether or not a person will use it and the person's perception of the overall app quality (Schueller et al., 2018). Studies have even shown how the ease of use and aesthetics increased the use of apps and indicated that aesthetics is an important area of focus (Schueller et al., 2018). With beautiful interfaces, we found that our app sample aligned with previous evidence to support strong aesthetics.

In terms of the information that the apps contained, not all of the apps were evaluated in clinical trials, but many of them did contain evidence-based techniques. The quality of information on each one varied greatly, with some apps simply having a technique with no explanation or having modules filled with information.

Implications for clinical practice

While clinician time and app quality remain barriers to clinical uptake of apps, researchers are beginning to propose practical frameworks to assist clinicians in evaluating the utility, safety, and efficacy of apps (Tourous et al., 2016). To promote implementation into clinical practice, clinicians may quickly refer to repositories of mental health apps. We relied on the end-user uMARS assessment tool, however, other professional agencies have established their own indicators of quality. The American Psychiatric Association characterizes quality based on background information, risk/privacy and security, supporting evidence, ease of use, and interoperability (APA, 2020). Other repositories, such as Psyberguide, train staff to evaluate app quality by credibility, user experience, and transparency. The credibility score represents how strong the scientific research support is for the app. The user experience score uses the Mobile App Rating Scale (MARS) to assess the overall experience of using the app. Transparency

reviews an apps privacy policy, and how clear they are about sharing user information. As of March 2020, the American Depression and Anxiety Association has a list of apps reviewed by mental health professionals with degrees in psychology, medicine, social work, and counseling. Apps are gauged based on ease of use, effectiveness, personalization, interactivity, and supporting evidence. The full list is available on their website (https://adaa.org/finding-help/mobile-apps). We also suggest that clinicians explore apps by downloading themselves (Yang et al., 2018). Clinicians may also want to test on self prior to recommending (Yang et al., 2018). Our findings reaffirm previous research that even though evidence related to app quality is improving, apps should not be recommended as a standalone psychological intervention (Weisel et al., 2019).

Limitations

Privacy was not something that was collected, yet important to consider when supporting an individual's health. Even though this information was not collected in this specific study, it is still vital. In many cases, users unknowingly give access to their private information, making it possible to identify who they are even if the app is designed to make the user "anonymous" (Paspatis et al., 2017). This particularly happens when users hit "I Agree" to user agreement statements without fully reading what they are agreeing to. Even if the user were to read the agreement statement, it has been found that apps sharing data is still pretty common because the agreements are not transparent (Grundy et al., 2019). It would help consumers know which apps are protecting their rights to privacy, and which are not.

Conclusion

Of the several stress-management apps found in the Apple App Store and Google Play Store, we evaluated14 that yielded acceptable quality scores. Though they scored well, there still

remains room for improvement, particularly in terms of their engagement and information scores, user privacy/information control, and application in pediatric populations. Aesthetically, stress-management apps are scoring well, but supporting evidence for such apps needs to be improved. To have a meaningful impact on health, it is important to continuously evaluate app quality in an effort to guide meaningful design and development.

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